ON THE POROSITY OF L AND H CHONDRITES. L. J. Pesonen[1], K. Kuoppamäki[2], J.Timonen[2], J. Hartikainen[2], M. Terho1 and K. Hartikainen[2], [1]Laboratory for Palaeomagnetism, Geological Survey of Finland, P.O. Box 96, FIN-02151 Espoo, Finland, [2]Department of Physics, University of Jyväskylä, FIN-40351, Jyväskylä, Finland.

Porosity is an important physical quantity in meteorite research. For example, porosity plays a major role in calculating or experimentally determining the Hugoniat curves for meteorites [1,2]. Physical properties of meteorites (such as density, magnetic susceptibility, intensity of NRM, the Koenigsberger ratio and magnetic hysteresis properties) have been used to classify meteorites rapidly and harmlessly into main classes and chemical-petrological groups [e.g. 3]. However, porosity causes a large scatter in density data and thus reduces the succesful application of these classification methods. In distinguishing the primary and secondary consolidation states of the meteorite parent bodies, and in assessing the type of the meteorite parent body with the help of meteorite data, the nature of porosity in the samples is of great importance [e.g. 3,4].

Recently, we started to measure porosities of meteorites in order to to see whether there are any differences in porosity between meteorite classes, and in particular between chemical-petrological groups of them as theoretically expected [4–6]. Another aim in our study is to seek possible correlations between porosity and other physical parameters of meteorites such as the shock index, magnetic anisotropy and state of weathering [4–8]. These data can be used to study the various events that meteorites have undergone in their parent bodies and during their subsequent history.

The porosity data are included in a new database of petrophysical properties of meteorites recently built at the Geological Survey of Finland [9]. This database includes porosities of more than 40 meteorites measured in Finland or taken from literature. Unfortunately the porosities are not always measured with the same method. Thus, some of the observed differences in porosity values of the same meteorite may be due to a variety of used techniques. The Finnish porosity data are based on two methods: (i) the determinations of the dry and wet masses of the samples (water immersion method) [3,10], and (ii) the Helium-pycnometer method [11,12]. Both yield values of the apparent porosity.

Figure 1 shows the comparison of porosities by the two methods as measured on the same samples. We can notice an overall good correlation (r = 0.99) with a slope of 0.84, which departs slightly from the ideal line (slope = 1): the He-pycnometer porosities appear slightly lower than the water-immersion porosities. This could be a real phenomen suggesting that the two methods may measure a different concept of the porosity, but some of the departures may be due to micro-porosities, weathering effects or the surface roughness of the samples, which causes problems in water immersion method [10,12]. However, the database is still small and this result will be tested with more samples. Here we report the main results of porosity data of L and H chondrites.

Figure 2 shows the porosity vs. the degree of shock for L and H chondrites and their chemical-petrological types. The shock index data are taken from literature [e.g. 2 and references therein]. In the case of L chondrites the porosity seem to decrease with the increasing shock: the H chondrites show this trend less clearly [see also 4,5,8,13]. Both data sets also reveal a trend that the lower petrological types (L4, H4) appear to be less porous and less shocked than the higher petrological groups (L5-6, H5-6) consistent with other recent data [4,13]. There are, however, exceptions for this trend [e.g. 6,8] and it seems that several physical factors in addition to metamorphism and shock are effecting together and producing a variety porosities within a petrological group [5–7,13].

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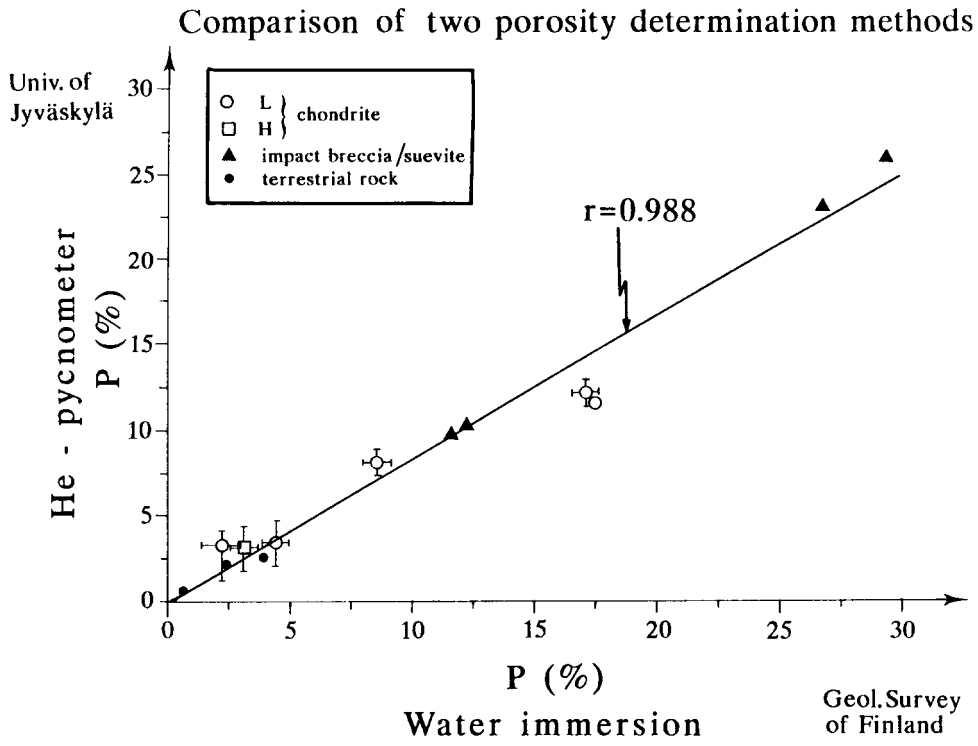

Fig.1. Comparison of porosities of L and H chondrites and some terrestrial rocks by two measuring techniques (water-immersion, He-pycnometer) [10–12].

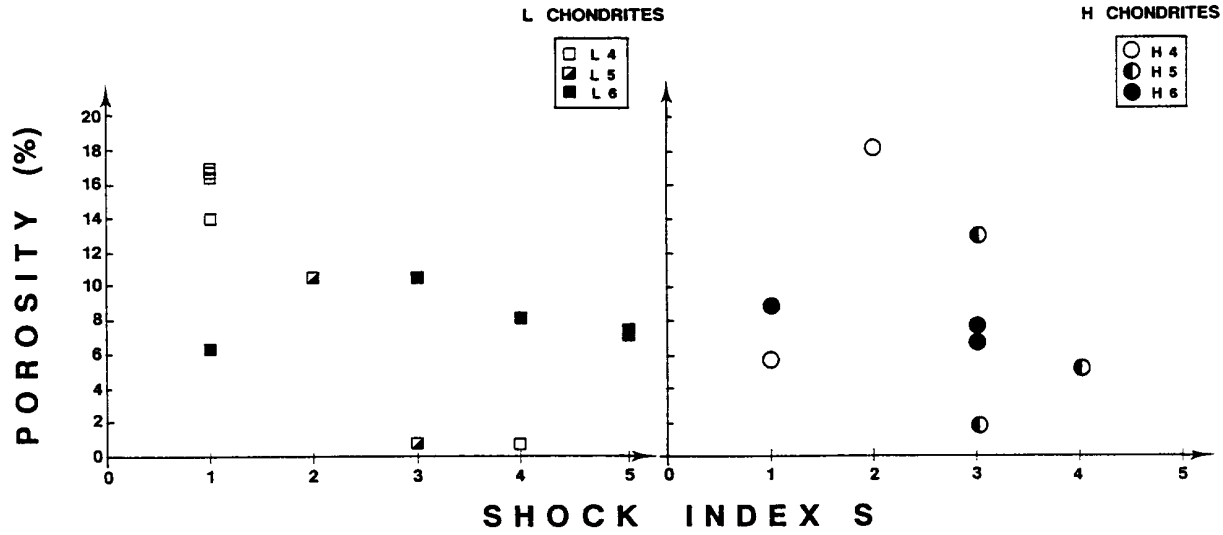

Fig.2. Porosity vs. shock index of L and H chondrites and their chemical-petrological groups.